

Annual Project Summary

Quaternary Fault Mapping of the Range Front Thrust Faults, Northeastern Santa Cruz Mountains/Southwestern Santa Clara Valley, California: Collaborative Research with Sanders & Associates Geostuctural Engineering, Inc., and U.S. Geological Survey

U.S. Geological Survey
National Earthquake Hazard Reduction Program

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NEHRP Program Element: I
National and Regional Earthquake Hazards Assessments

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Investigations Undertaken

A series of northwest-striking, southwest-dipping thrust and reverse faults are mapped along the northeastern range front of the Santa Cruz Mountains/southwest margin of Santa Clara Valley from near Loma Prieta to Daly City (Figure 1). The faults, herein referred to as the range front fault system, are of particular interest because of their proximity and tectonic relationship with the nearby San Andreas fault, and because of increasing urban development along many of the fault traces. The faults locally offset and deform late Quaternary sediments and geomorphic surfaces, as well as younger probable Holocene soils (Hengesh et al., 1996; Rubin et al., 2004).

Recent geomorphic investigations of the thrust faults and detailed site-specific fault hazard investigations for proposed development have provided a greater understanding of their activity and their contribution to seismic hazards in the San Francisco Bay region. Fenton and Hitchcock (2001) summarized fault data for several of the thrust faults near the south end of the system, based in part by research compiled on San Francisco Bay Region thrust faults by Jayko and Lewis (1996). Most recently, Kennedy and Hitchcock (2004) compiled informal fault summary papers in a guidebook for a field trip in March 2004 focused on the range front fault system. However, no effort has been made to date to compile, evaluate, and publish mapped fault traces and fault data from both regional and site-specific studies for the entire thrust fault system.

This objective of this study was to compile existing fault data for the entire thrust fault system, and prepare a GIS digital database of Quaternary active fault traces to be incorporated into the San Francisco Bay Region (SFBR) Quaternary Fault Database currently being developed by the U.S. Geological Survey.

During the course of this study, available existing published and unpublished data for the thrust fault system was acquired from numerous sources, including the U.S. Geological Survey, California Geological Survey, and County of Santa Clara. Relevant fault data was also provided by several local geologic/geotechnical consultants, particularly Cotton, Shires & Associates, Inc. (CSA). CSA serves as the City or Town Geologic/Geotechnical Consultant for several range-front communities, including Cupertino, Saratoga, Los Altos Hills, and Portola Valley.

Using ArcGIS software, individual fault locations were compiled from regional mapping efforts by Pampeyan (1993), Bonilla (1998), Brabb et al. (1998), Brabb et al. (2000), and McLaughlin et al. (2001). Where possible, the fault trace locations were further refined using:

- detailed mapping data from geomorphic investigations of the thrust faults, such as Hitchcock et al. (1994), Angell et al. (1997), and Bullard et al. (2004);
- City or Town geologic maps for Woodside (Dickinson and others, 1992); Portola Valley (Rodine, 1975); Los Altos Hills (CSA, 2004), Cupertino (CSA and City of Cupertino, 2003), and Saratoga (William Cotton and Associates, 1980; Terratech, 1985), and Los Gatos (Nolan Associates, 1999);
- selected site-specific fault hazard investigations for site development; and
- unpublished geologic mapping data contained in the field trip guidebook compiled by Kennedy and Hitchcock (2004).

From a digital database of more than 7,300 individual fault segments, pre-Quaternary faults were vetted, leaving approximately 1,100 Quaternary active fault segments. The thrust faults depicted on Figure 1 represent these Quaternary fault traces generated. Using the available data, the individual fault traces were annotated in the digital database with the following information:

1. Fault name (e.g., Sargent, Berrocal, Shannon, Monte Vista, etc.).
2. Fault rank (e.g., Primary, Secondary, Tertiary, Questionable).
3. Recency of fault activity (e.g., Historic, Creeping, Holocene, Potentially Holocene, Quaternary, and Potentially Quaternary).
4. Author of mapping and year published.

Interpretations regarding recency of fault activity were based on information from available published geologic maps, geomorphic investigations, and site-specific fault hazard investigations where trenching was performed.

Results

This study has yielded a digital database of Quaternary active thrust faults along the northeastern range front of the Santa Cruz Mountains for integration into the SFBR Quaternary Fault Database. The digital database represents the compilation of available published and unpublished fault data into a usable format, particularly with respect to fault trace locations and recency of fault activity.

These results directly addresses NEHRP Element I to “contribute to improvements in the national hazards maps, and assess earthquake hazards and reduce losses in urban areas”. In addition, dissemination of these results to the local geologic, engineering, and regulatory communities is essential for making informed decisions on community planning and engineering as urban growth continues.

Non-Technical Summary

This study has compiled previously mapped thrust faults along the northeastern margin of the Santa Cruz Mountains from near Los Gatos to Daly City, California. The faults are of particular interest because of uncertainties regarding their level of activity coupled with increasing urban development along many of the fault traces. Approximately 1,100 Quaternary active fault segments were identified and incorporated into a digital database using geographic information system (GIS) software. The GIS digital database has been integrated into the San Francisco Bay Region Quaternary Fault Database currently being developed by the U.S. Geological Survey.

Reports Published

None.

Data Availability

The digital database generated during this study has been incorporated into the SFBR Quaternary Fault Database, which will be released by the U.S. Geological Survey as part of the 1906 San Francisco Earthquake Centennial Commemoration in April 2006. Additional detailed information regarding this study is available from the Principal Investigator listed above.

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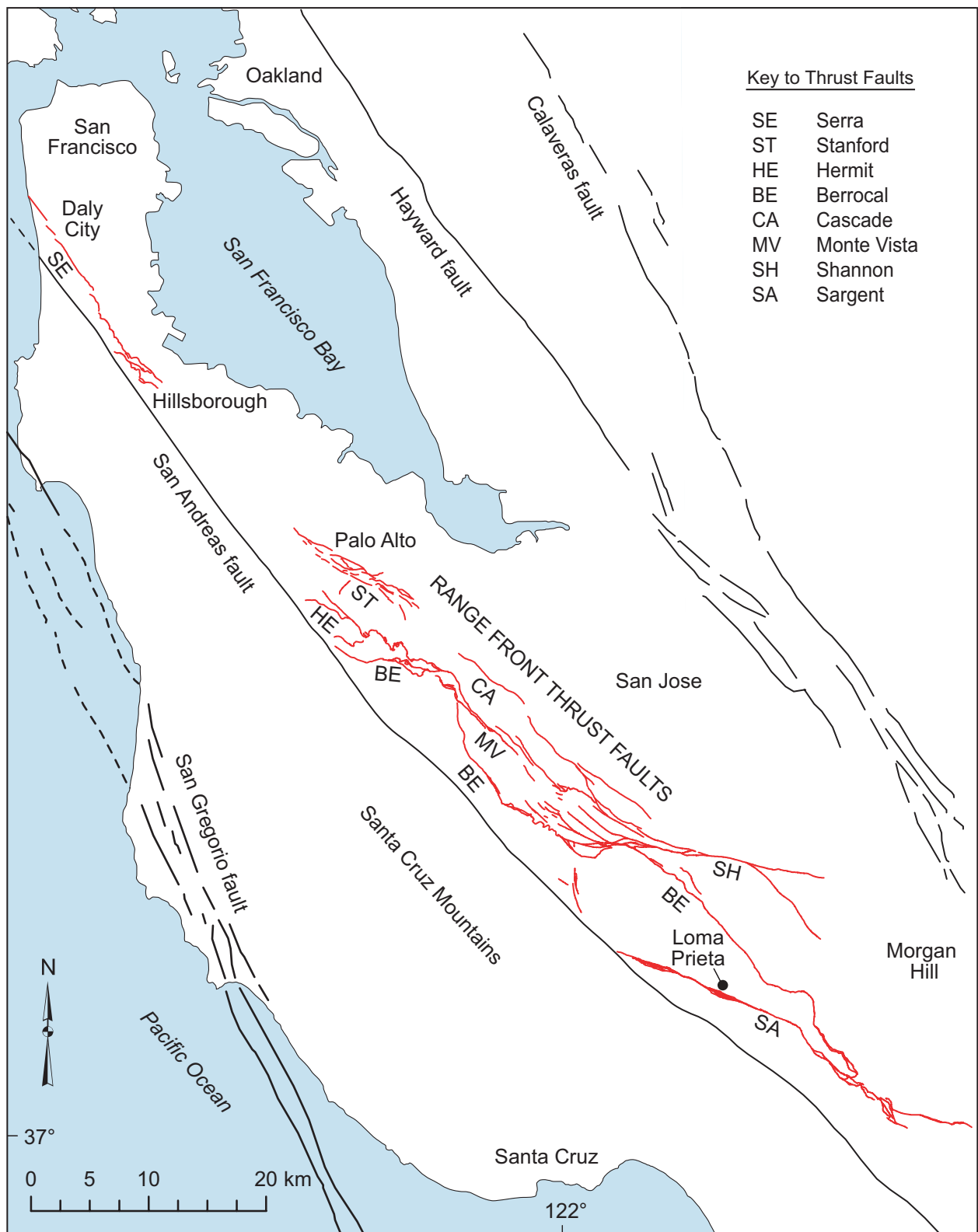


Figure 1 Map showing the range front thrust faults (in red) and the primary Holocene faults in the southern San Francisco Bay region. Modified from Jennings (1994), Brabb et al. (1998), Brabb et al. (2000), and McLaughlin et al. (2001).